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Permanence and Ultimate Boundedness for Discrete-Time Switched Models of Population Dynamics

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Abstract: The problems of permanence and ultimate boundedness for a class of discrete-time Lotka–Volterra type systems with switching of parameter values are studied. Two new approaches for the constructing of a common Lyapunov function for the family of subsystems corresponding to a switched system are suggested. Sufficient conditions in terms of linear inequalities are obtained to guarantee that the solutions of the considered system are ultimately bounded or permanent for an arbitrary switching law. An example is presented to demonstrate the effectiveness of the obtained results.

Keywords: *population dynamics; ultimate boundedness; switched system; discrete-time models; common Lyapunov function; linear inequalities.*

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1 Introduction

The Lotka–Volterra type differential and difference equations systems are extensively used in modeling of population dynamics [6, 7, 9, 12, 14, 15]. A very important ecological problem associated with multispecies population interactions is the following one: whether or not the densities of all species are bounded [5, 7, 9, 15]. Of particular interest is the situation when there exists a bounded region in the phase space of the system, such that every solution enters this region for finite time and remains within it thereafter. Solutions of systems possessing this property are called ultimately bounded [6, 7].

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